

Section 8.4

PERMEABLE ROAD BASE

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When surface water or groundwater is intercepted by a linear project such as a road, subsurface drainage techniques are required to drain the area and provide a solid base. Whenever possible, the roadgrade line should be placed above the watertable and well graded granular materials should be used for fill to prevent water from being drawn up into the fill by capillary action. Although the cost of installing such a drainage system is more than a normal road system, the long-term costs for maintenance will be reduced.

A good understanding of the seasonal groundwater fluctuation and any variation in lateral and vertical permeability is critical. But field investigations should be carried out during the wet season if possible to assess the groundwater table along the proposed route. Other necessary information is the soil's structure, the slope of the area and the native vegetation. However, because the initial investigation may not always identify all subdrainage problems for the road, it is critical that if discovered during construction, the road design must be altered at that time to incorporate a system that will allow unimpeded drainage.

The permeable road base (other common names are the French mattress or the rock sandwich) is a specialized road base

consisting of coarse rocks that will allow water to freely pass and be discharge as sheet flow on the downgradient side of the road. It is designed to be used in wetlands to pass surface water and in road cuts and fills where the cut extends below the seasonal groundwater table in soils which groundwater seeps seasonally. It may be as narrow as a few feet or over several hundred feet. A permeable road base, unlike a culvert, does not concentrate water to a single entry and exit point but spread the water out over a distance equal to the width of the wetland crossing or intercepted groundwater thereby reconnecting the natural hydrology. Groundwater has enough latent heat to prevent the drainage layer from freezing. It is not designed to be used in concentrated flow areas or to handle just runoff water. It can be used in conjunction with a culvert if the wetland has concentrated flow channels or if the road cut is below seeping groundwater from the embankment, a surface water discharge in a low swampy area or the groundwater table.

The benefits of a permeable road base are as follow:

- They reconnect intercepted hydrology in a much more natural manner than culverts.
- When dispersed to a vegetated buffer, they assist in the treatment of road runoff by non-structural

methods avoiding the need for costly and time consuming installation of structured systems.

- They require little maintenance compared to cross-culverts.
- They have a wide discharge area that does not concentrate flows which can scour soil similar to the discharge from a culvert.
- They significantly strengthen the road base on soft soils.
- They prevent groundwater from wicking up into the road fill material; thus minimizing the potential for frost action and potholing.
- They provide an indefinite service life compared to a cross-culvert.

The following linear types of subdrainage systems are acceptable if a discharge point is established on a narrow spacing and if the discharge is a stable area that will allow the dispersion of flow via a level spreader.

1. Pipe underdrain. This system consists of perforated pipe placed at the bottom of a narrow trench and backfilled with a filter material such as coarse sand. It is generally used along the toes of cut or fill slopes. The trench should be below the groundwater surface and dug into a lower, more impervious soil layer to intercept groundwater. The drains may be made of metal, concrete, clay, asbestos-cement, or bituminous fiber and should be 6 inches in diameter or larger.

2. French drains. This system consists of trenches backfilled with porous material, such as very coarse sand or gravel. This type of drain is apt to become clogged with fines and is not recommended.

8.4.1 Site Suitability

The primary function of a permeable road base is to allow intercepted surface and/or groundwater to pass from one side of the road to the other over the entire width in which it is intercepted. Sites where the structure is most useful are for wetland crossings and for sections of road where cuts are made below the seasonal groundwater table where there is a large contributing watershed and the soils are medium to coarse textured so that there is a significant amount of groundwater passing through them. Commonly, the groundwater in these soils is oxygenated so they are not considered wetlands even though they have a high seasonal groundwater table.

8.4.2 General Design Criteria

The road base consists of 3" – 6" stone "sandwiched" between layers of permeable filter fabric through which water can freely pass from one side of the road to the other as sheet flow. Both ends of the layer must be exposed so that water can enter and pass through it unimpeded. A permeable road base structure should be used in areas of:

1. Non-concentrated flows: areas where concentrated flows from a pipe may be undesirable, impractical, or regulated.

2. Road impoundment: In areas where a road is acting as an impoundment or dam to the natural water flow by isolating subsurface water on one side of the road from the other.

3. Shallow bedrock depth: Areas where placement of a pipe at the depth necessary to provide structural cover would lower the natural water table of the area and require long term maintenance.

4. Wetland crossing: Low-lying areas near streams or wetlands where maintaining sheet flow would be difficult.

5. Road load bearing: A filter fabric and rock layer in the lower portion of a road provides bearing strength. The water collects in the voids provided by the larger rock and moves away by gravity rather than softening the subbase soils.

8.4.3 Specific Design Criteria

1. Site Preparation: To minimize the alteration of wetlands, do not stump and grub wetland surfaces under the road footprint. Cut trees close the ground, leaving the stumps in place which will provide added structural support to the additional weight. This woody debris will not decompose as it will be anaerobic. The intact soil surface is less of a threat to move and plug up the drainage layer. In cut and fill roads, minimize ground disturbance and avoid excavating ditches!

2. Bottom geotextile: After the site has been prepared, place a permeable woven/non-woven filter fabric over the length of roadway. Filter fabric “joints” should overlap by at least 18”.

3. Material: the core material of the drainage layer is a minimum of 12” thick

layer of clean 3”-6” diameter stone on the fabric for the full width of the roadway.

4. Top geotextile: Place permeable, non-woven filter fabric on top of the entire length of rock layer. Do not cover the upgradient and downgradient sides (lateral sides of the road) of the rock layer with filter fabric or soil. Leave these areas exposed so that surface water from the upslope part of the wetland can pass unimpeded to the downslope part of the wetland.

5. Upgradient soil disturbance: If inadvertent soil disturbance has occurred on the upslope side of the permeable road base layer, place stone on the disturbed soil so that it will not migrate and plug the drainage layer.

6. Road fill and road base: Place additional road fill as designed and the driving surface material over the top filter fabric according to specifications and procedures (minimum of 6” recommended after compaction). However, when more than 2-3 feet of fill is needed to bring the road grade up to the desired elevation, a third layer of filter fabric should be added to provide structure to the fill and prevent the fines in the subbase from moving through the fill and to the permeable drainage layer.

7. Upgradient of cut slopes: Place a layer of 3”-6” stone on cut face up to the height of seeps. This allows for seepage to reach the permeable drainage layer in the roadbed while holding the soil in place.

8. Downgradient of fill slopes: Do not cover the downslope edge of the

permeable road base layer with geotextile so that water can freely be diffused back into sheet flow and that the slope is protected.

9. Culverts in a permeable road base structure: If the crossing has a stream, a defined drainage way or larger concentrated flows are anticipated, a culvert should be installed according to appropriate design standards. The culvert should be installed where its invert is at least 3” above the elevation

of the bottom of the drainage layer to assure that base flows can sheet flow through it rather than at the culvert which should activate only during high runoff flows.

8.4.3 Maintenance

Check upslope face of stone layer to prevent clogging by eroded soil, road sand, debris and leaf litter.